Predicting Future Encroachment - Based on Today's Regional Planning

Dr. Jim Westervelt
ERDC-CERL

Challenge

Influence regional planning …

… to sustain tomorrow's training

Need tools to

Test proposed regional investments and policies with respect to future changes in training opportunities - 20-50 years out

Regional Investments and Policies

- Investments
  - Construction of highways
  - Construction of ramps on limited access highways
  - County, state, and federal land purchases
  - Purchase of development rights

- Policies
  - Zoning
  - Level of growth stimulus

One present - Many possible future

Current Project Funding

- SERDP (Strategic Env. R&D Program)
  - Develop and publish approaches to predict urban growth and impacts on installations
  - Develop and test prototype models for Benning, Bragg, Carson, and Ripley

- Army Corps direct R&D funds
  - Fort Future
  - Develop Web-based ability to simulate installation processes
    - Building
    - Cantonment
    - Ranges
    - Regional

Bragg

- Deliverables
  - Base urban growth model
    - GIS maps and analysis procedures
  - Technical report providing analysis instructions using standard GIS software
  - Prototype web interface to allow simulations
    - Current regional planning impacts on future training opportunities

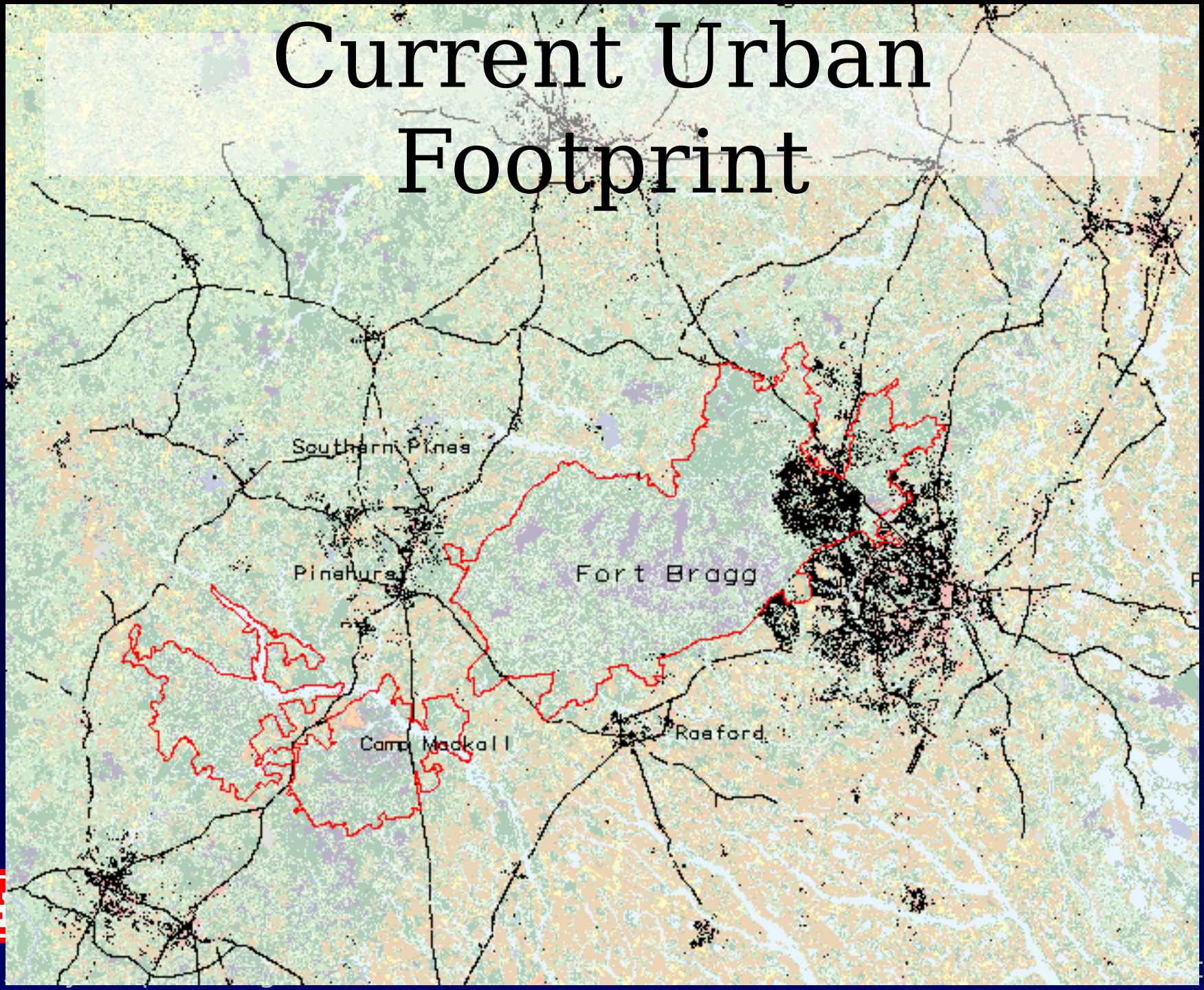
Current Prototype Demo

- Question
  - What is the relative attractiveness of land around Bragg to urban development?
  - What is a potential settlement pattern if the population increases by 30%
- Assumptions
  - Urban growth is based on
    - Population growth
    - Attractiveness of land to settlement

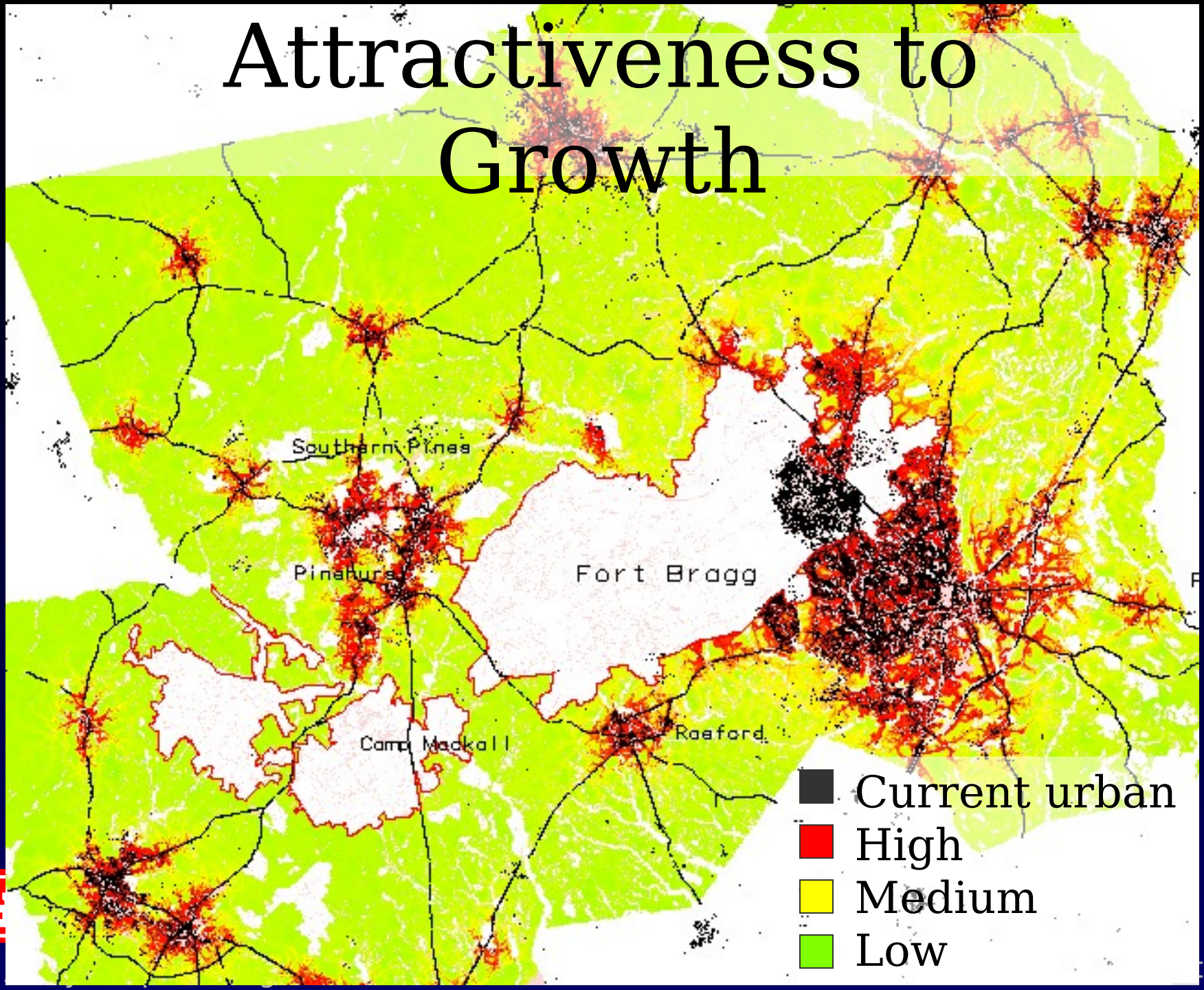
Approach

- Where do people want to live?
  - Consider attractiveness of
    - Small, medium, and large city centers
    - Limited access highways
    - State highways
    - Roads
  - Consider proximity to
    - Forest, water, other homes
- Where can building occur?
  - Consider soils, wetlands, no growth, zoning

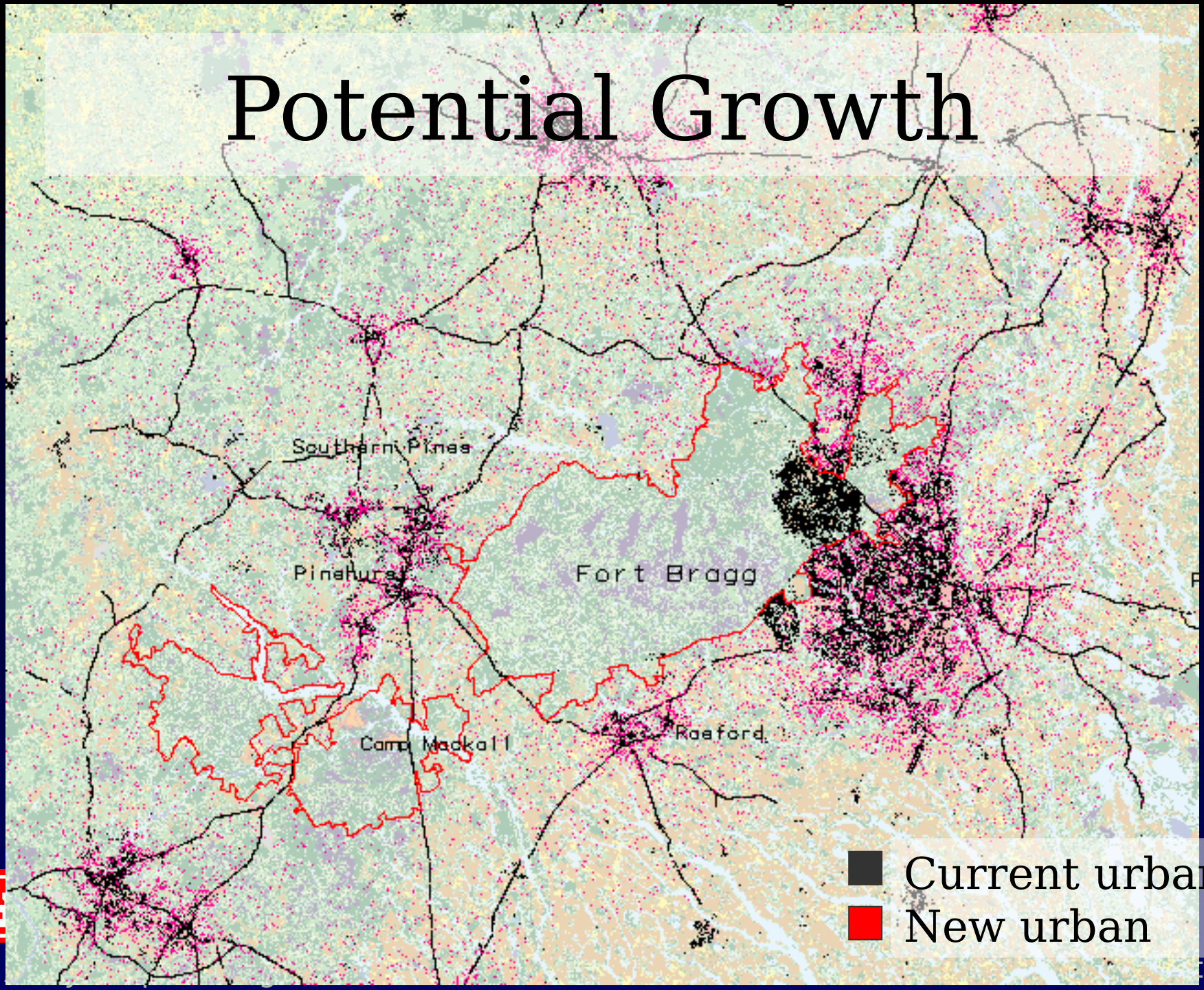
Current Urban Footprint



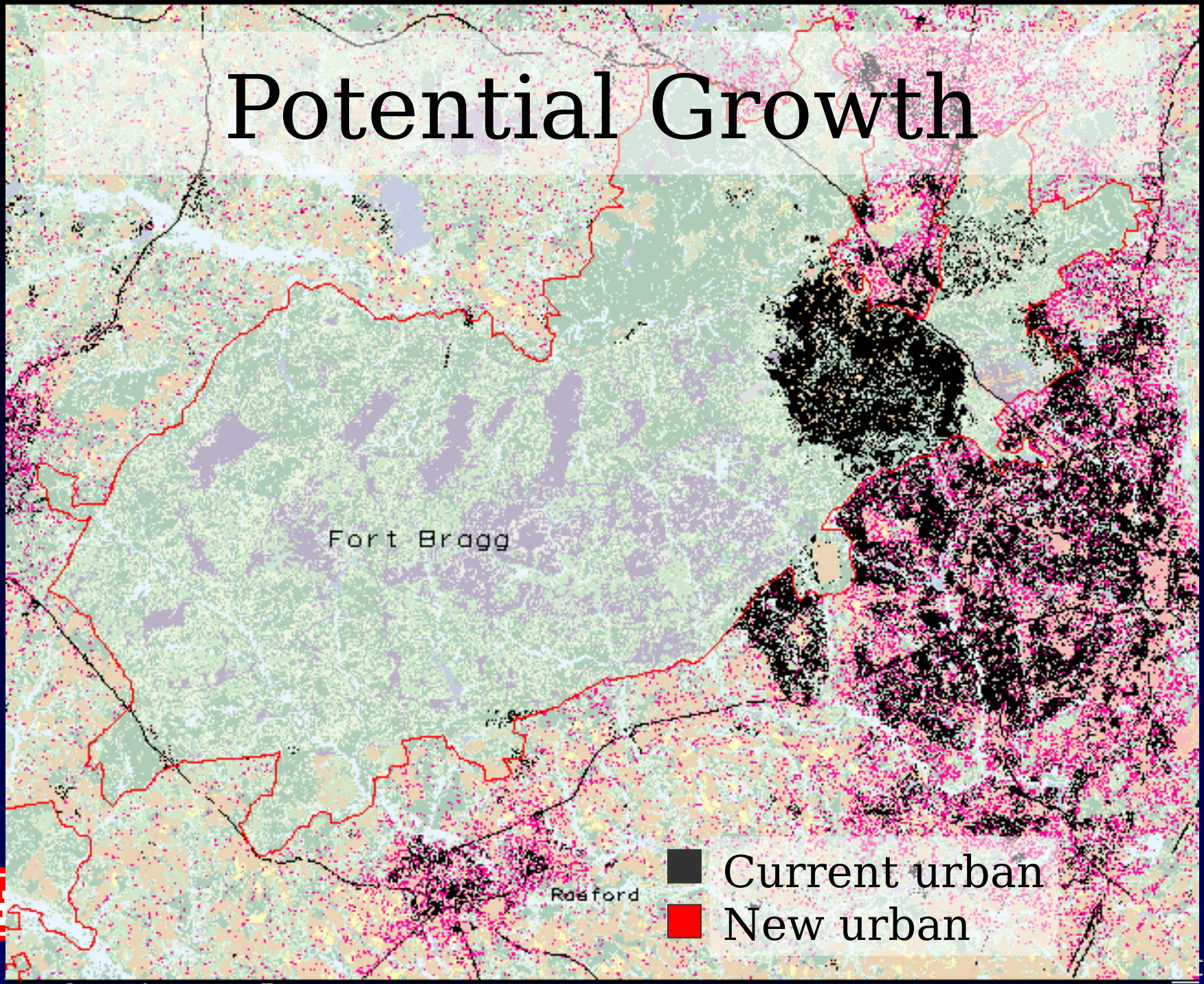
Attractiveness to Growth



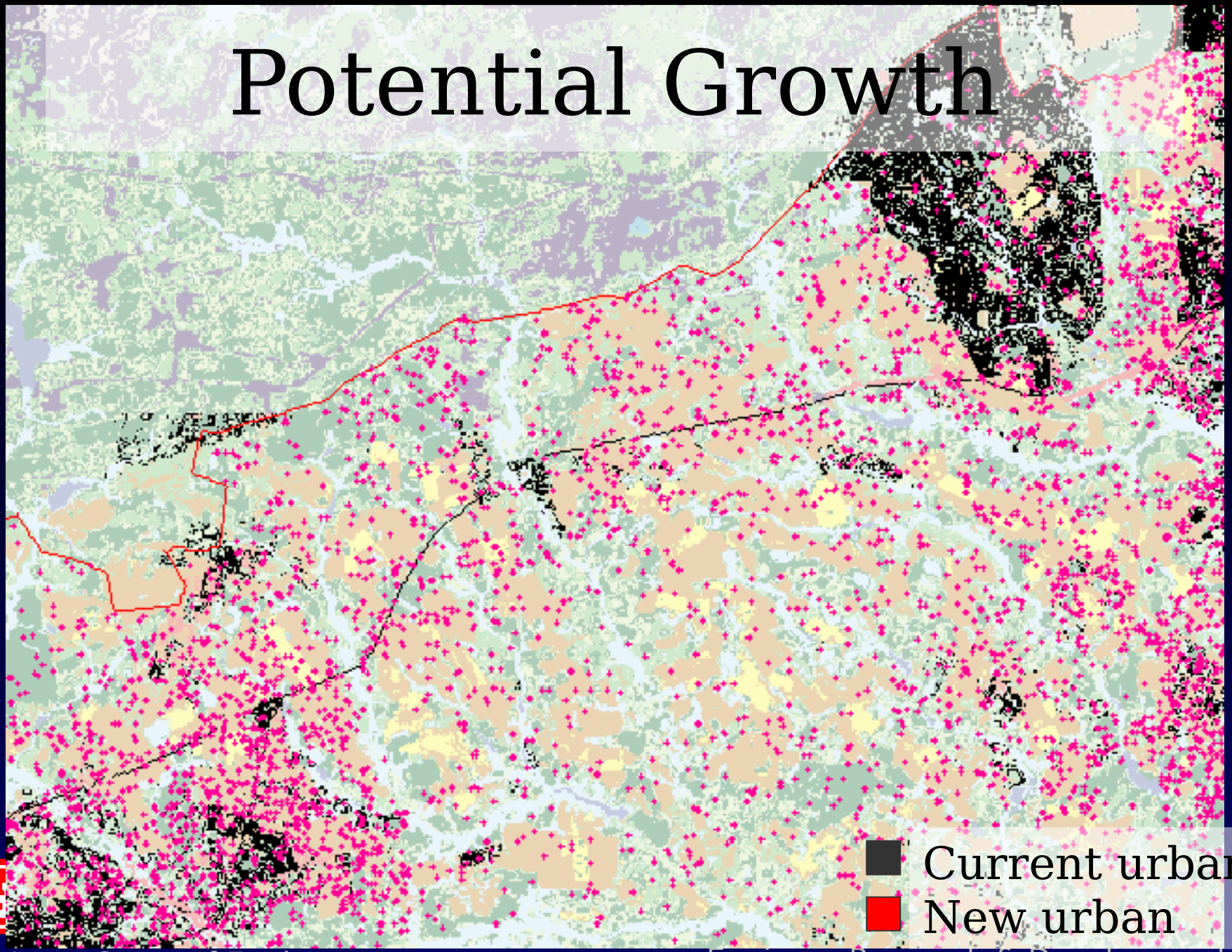
Potential Growth



Potential Growth



Potential Growth



Futures

- Many scenarios can be tested
- Ft. Bragg GIS shops can use and adapt our approach
- Refinements and modifications can increase usefulness and accuracy
- Local knowledge is critical to appropriate calibration and application

- Many thanks for Fort Bragg assistance/advice!!

Land Use Change Prediction Fort Bragg, NC

A Fort Future Initiative

ERDC-CERL

Dr. Jim Westervelt

Cast of Characters

- ERDC-CERL
  - Kyle Brock - student
  - Jim Westervelt
- U of Ill - Dept of Urban and Regional Planning
  - Brian Deal - LEAM Lab Director
  - Woonsup Choi - student
  - Jeff Terstriep - Senior programmer

User? Questions?

- Users
  - Installation planners, range control, and environmental offices
  - HQ Planners

- Question
  - How will proposed regional plans and investments affect future training/testing carrying capacity on installations?

Cause-Effect Chain

Training/Testing Capacity = f (Soil, weather, weapons, doctrine, terrain, vegetation, habitat, regional habitat, noise effects, dust/smoke effects, ambient light, RFI)

regional habitat = f (urban patterns)

noise effects = f (urban patterns)

dust/smoke effects = f (urban patterns)

ambient light = f (urban patterns)

RFI = f (urban patterns)

Urban Patterns = f (free-market land development)

Development = f (regional land use investments and policies)

Therefore:

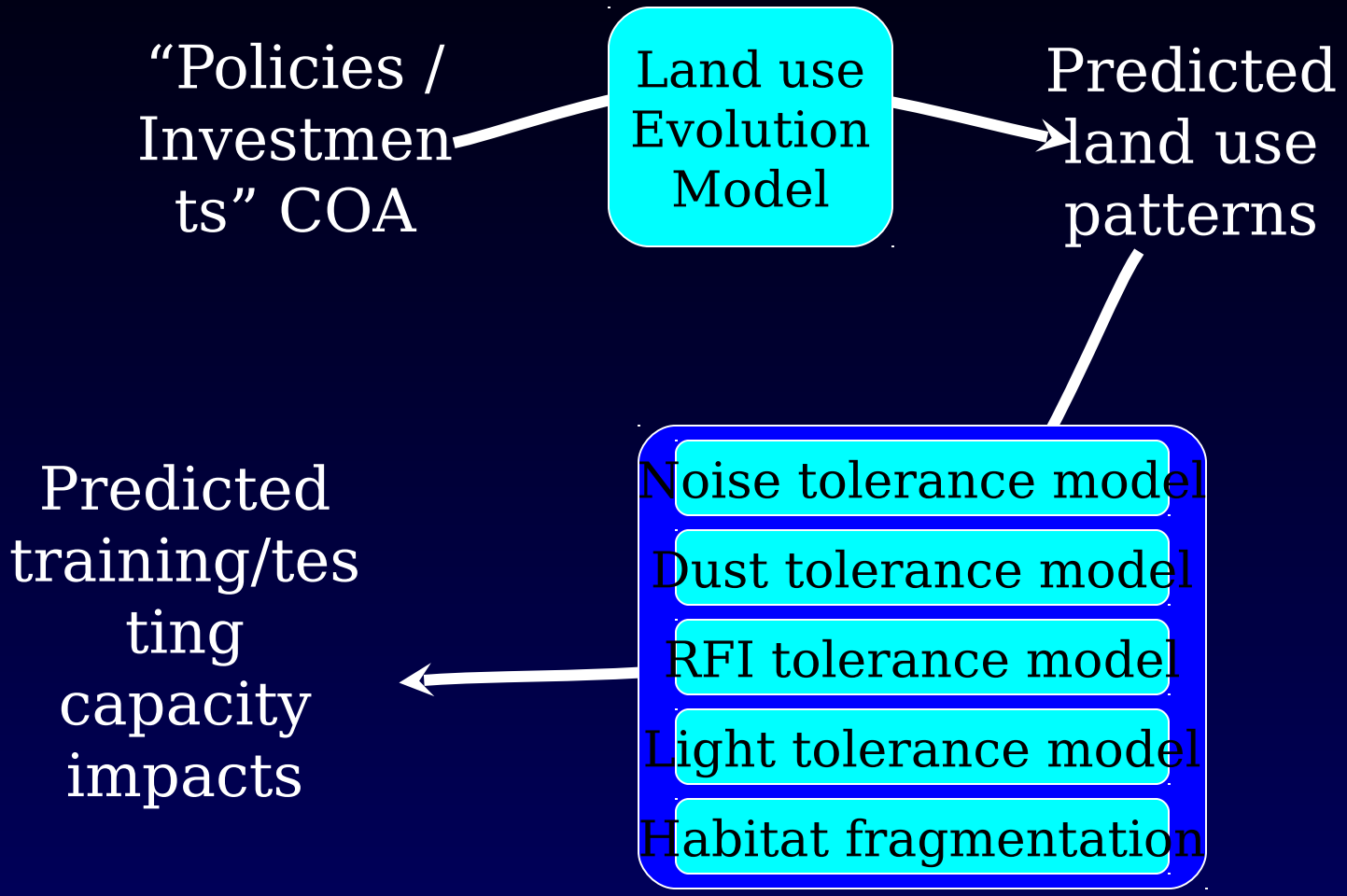
$$\text{Training and testing capacity} = f\left(\text{regional land use investments and policies}\right)$$

- Ultimate goal of the mLEAM program:
  - Allow users to interactively propose regional investments and policies
  - Provide rapid feedback on the training/testing capacity implications

Regional Investments and Policies

- Investments
  - Construction of highways
  - Construction of ramps on limited access highways
  - County, state, and federal land purchases
- Policies
  - Zoning
  - Level of growth stimulus

Overall Process



Preparation of Input Maps

Land Cover (2-3 decades)
- USGS NLCD

Digital Elevation
- USGS DEM

Boundary
- Census bureau UA/UC

Road Network
- Census bureau Tiger

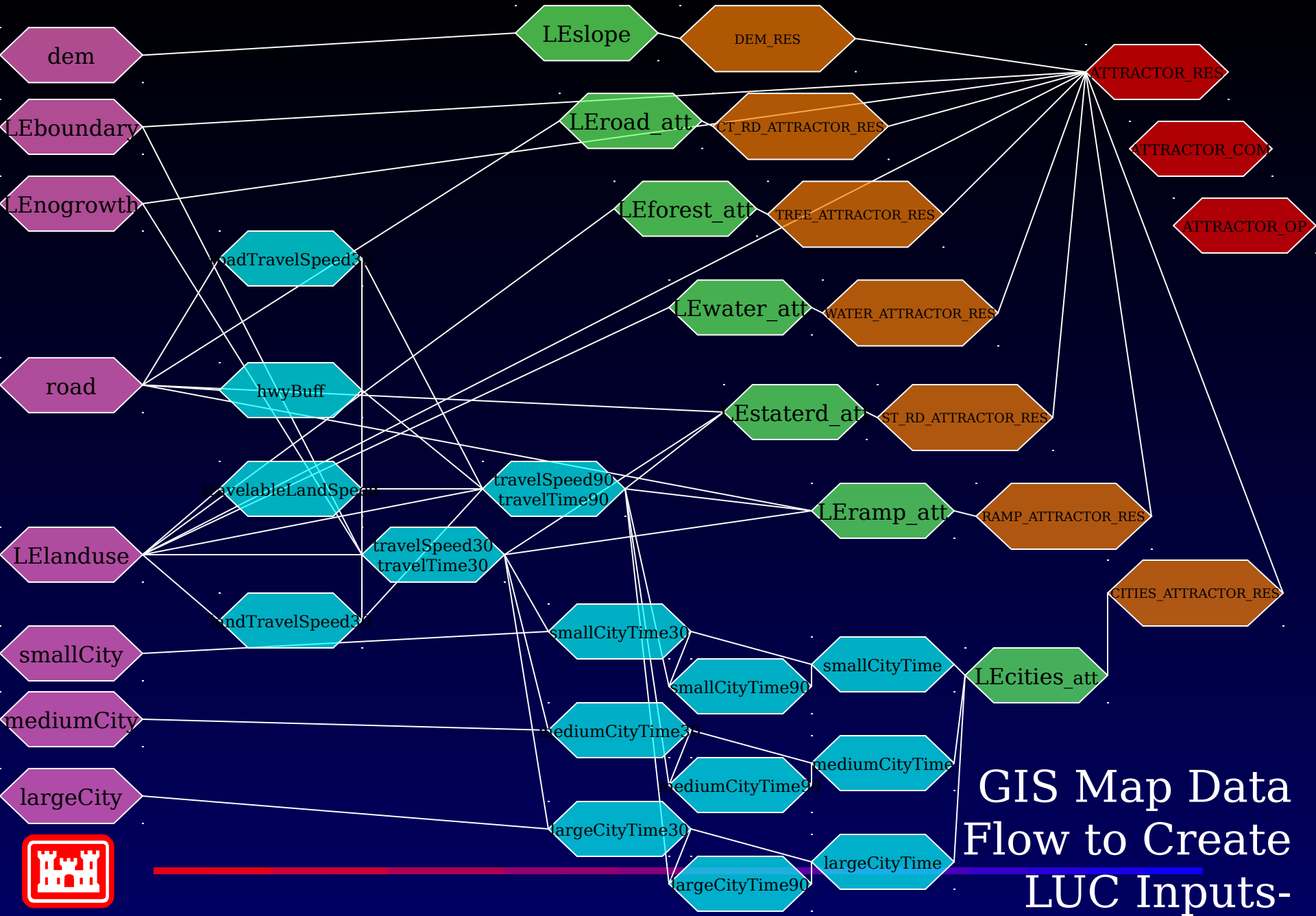
Property Ownership
- USGS, DoD, BLM, etc

Floodplain
- FEMA

GIS scripts

- Boundary
- Nogrowth
- Landcover
- Water_dist
- Forest_dist
- Slope
- Cities_att
- Highway_att
- Intersection_att
- Metrobuffer
- Ramp_att
- CountyRoad_att

Projection and coordinate conversion

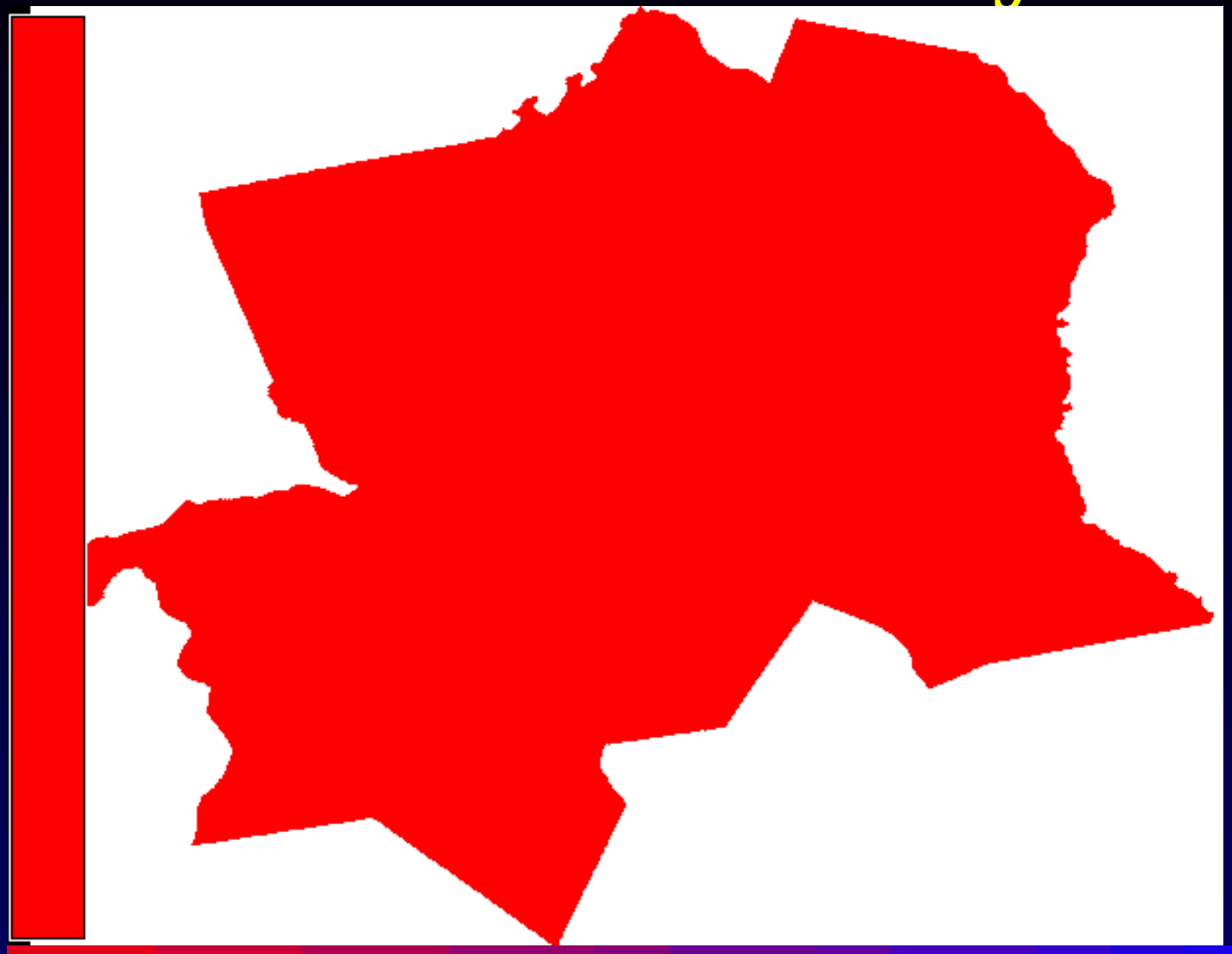


GIS Map Data Flow to Create LUC Inputs-2003

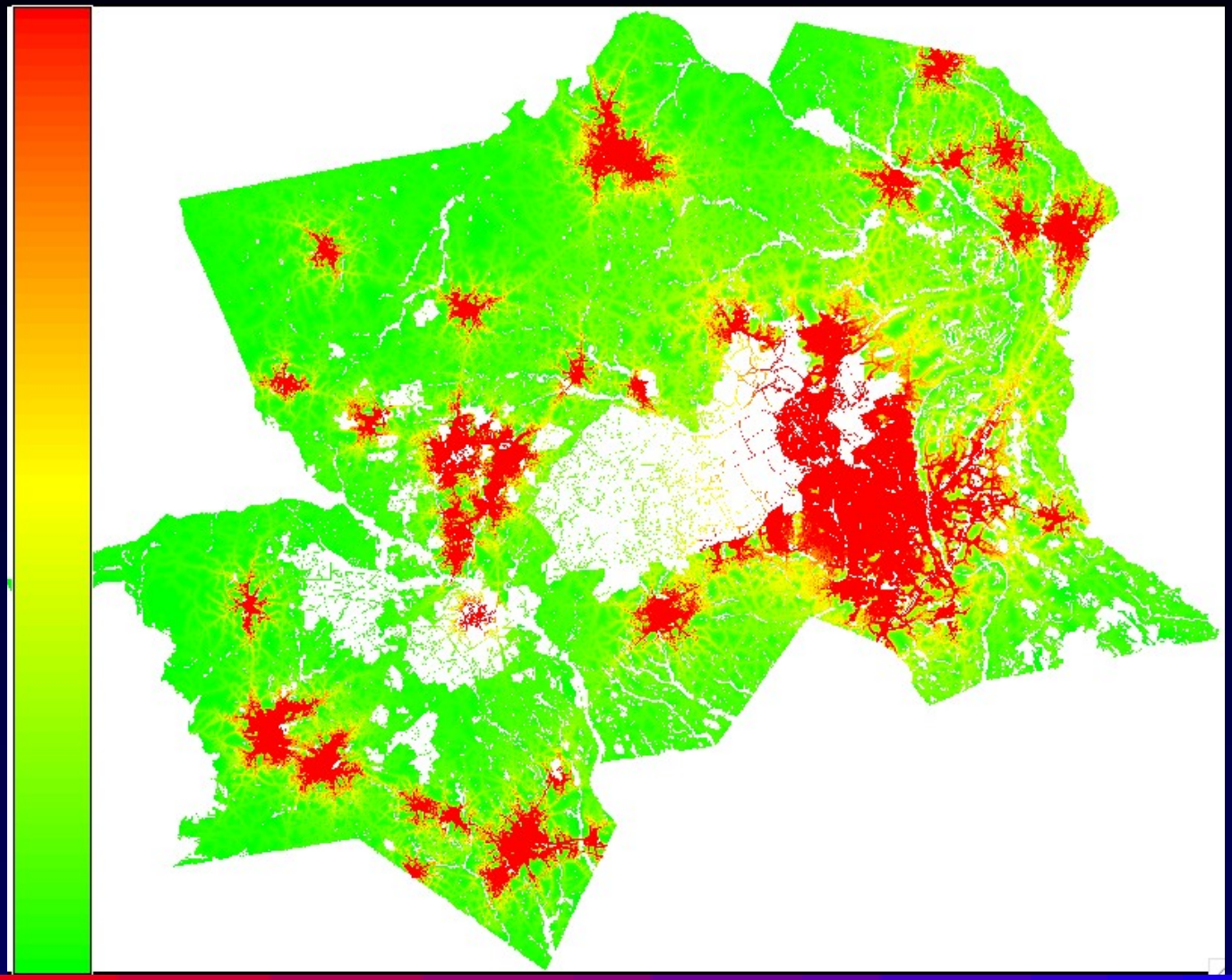
US Army Corps of Engineers

Engineer Research & Development

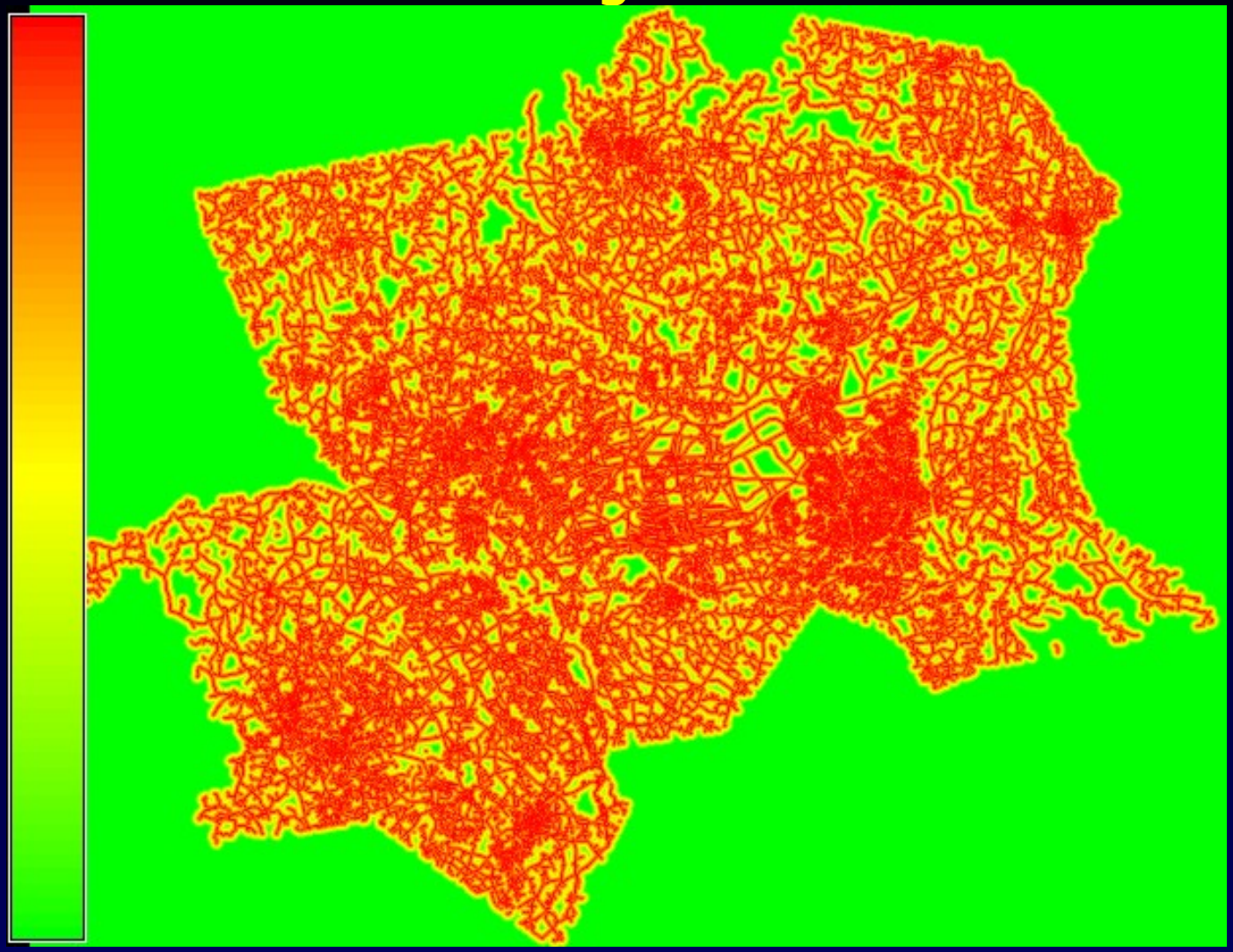
LUC Boundary



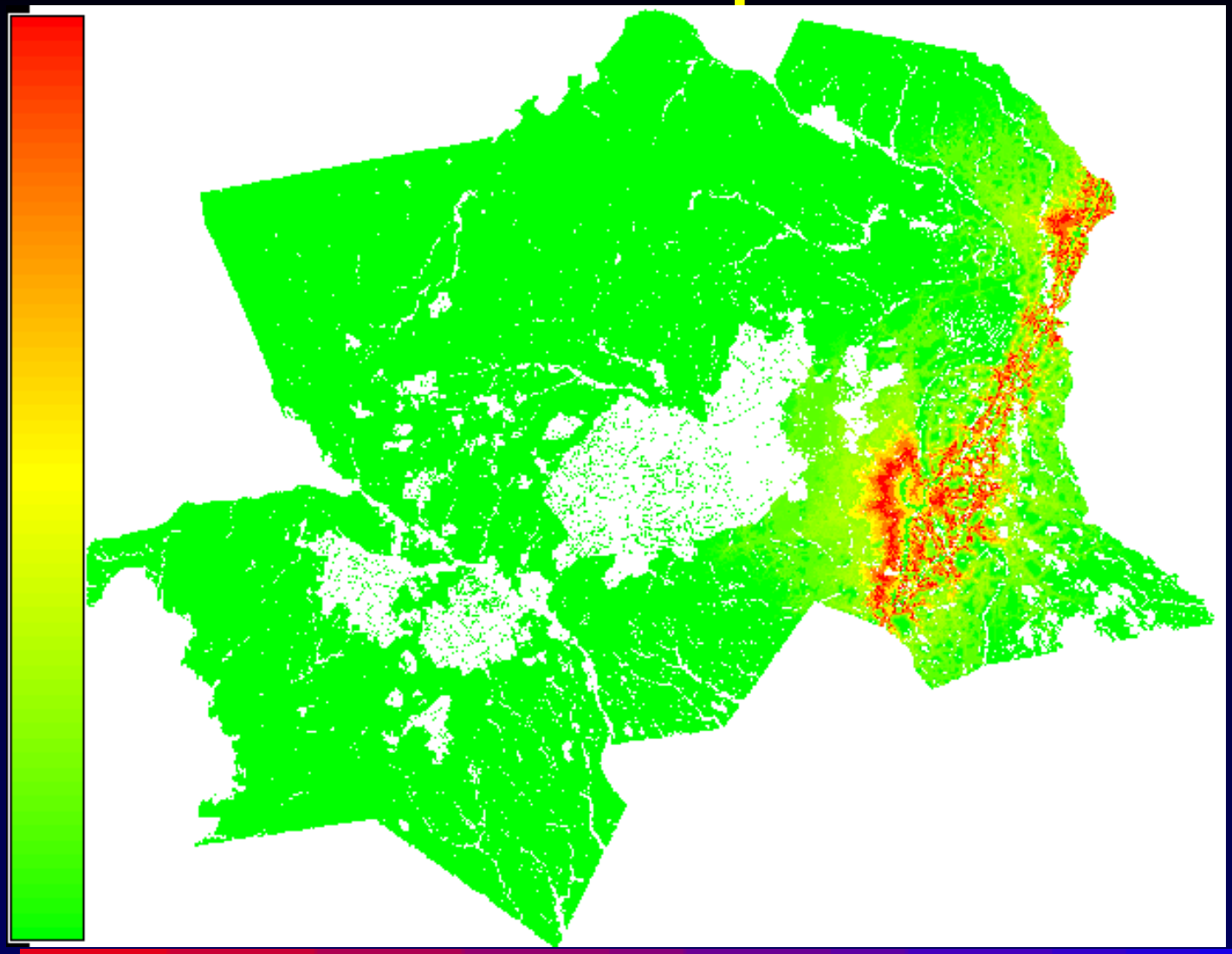
Cities



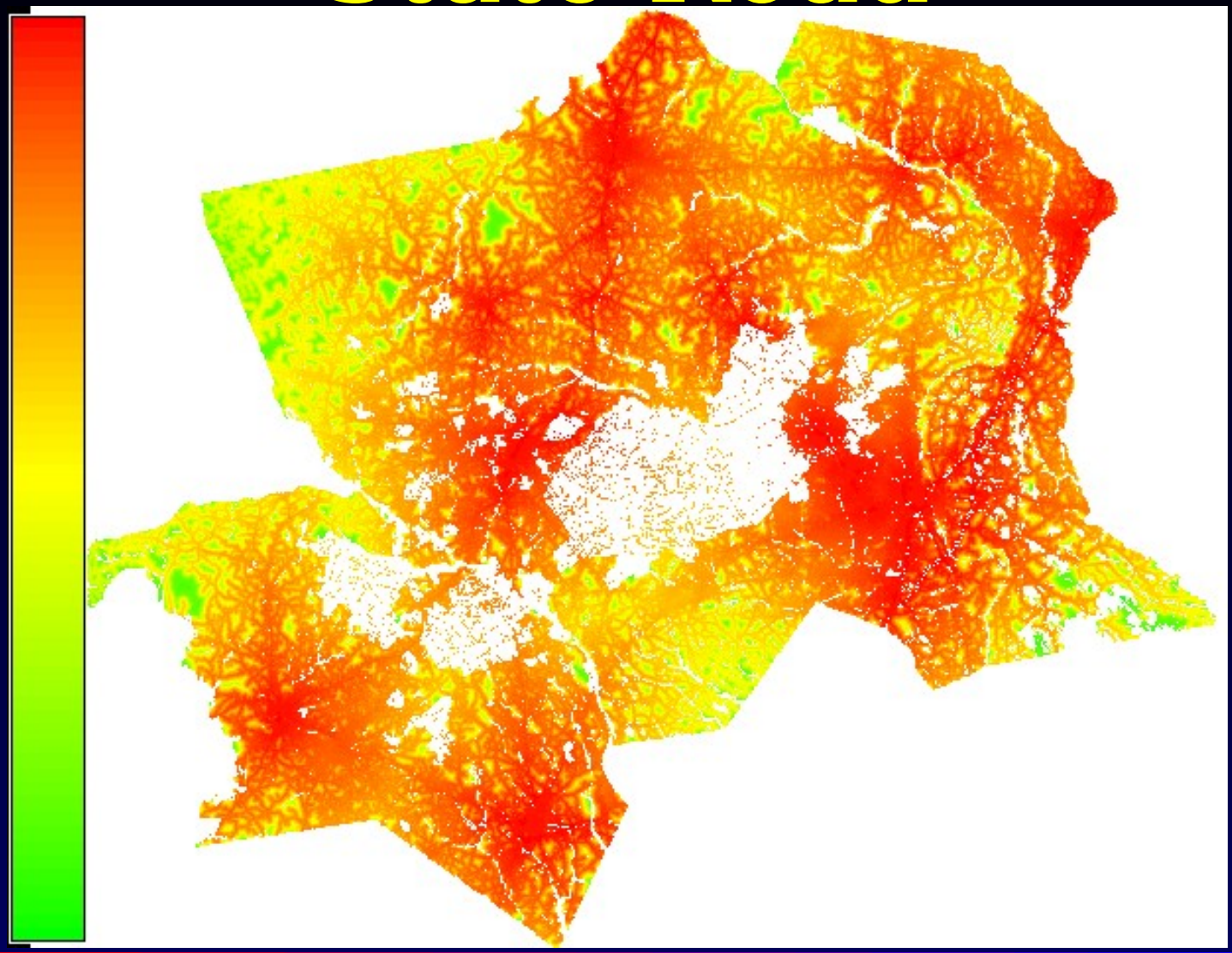
County Road



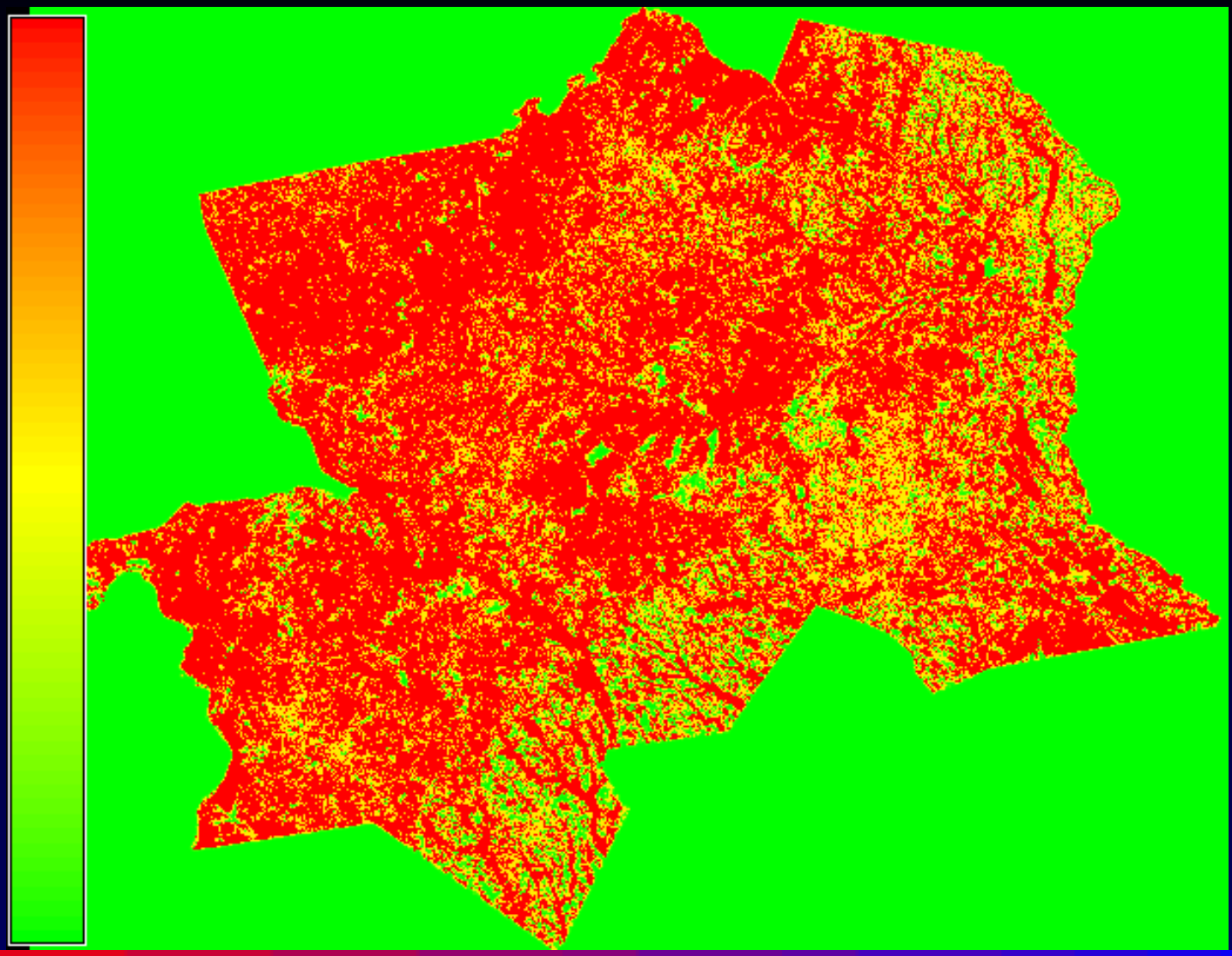
Ramps



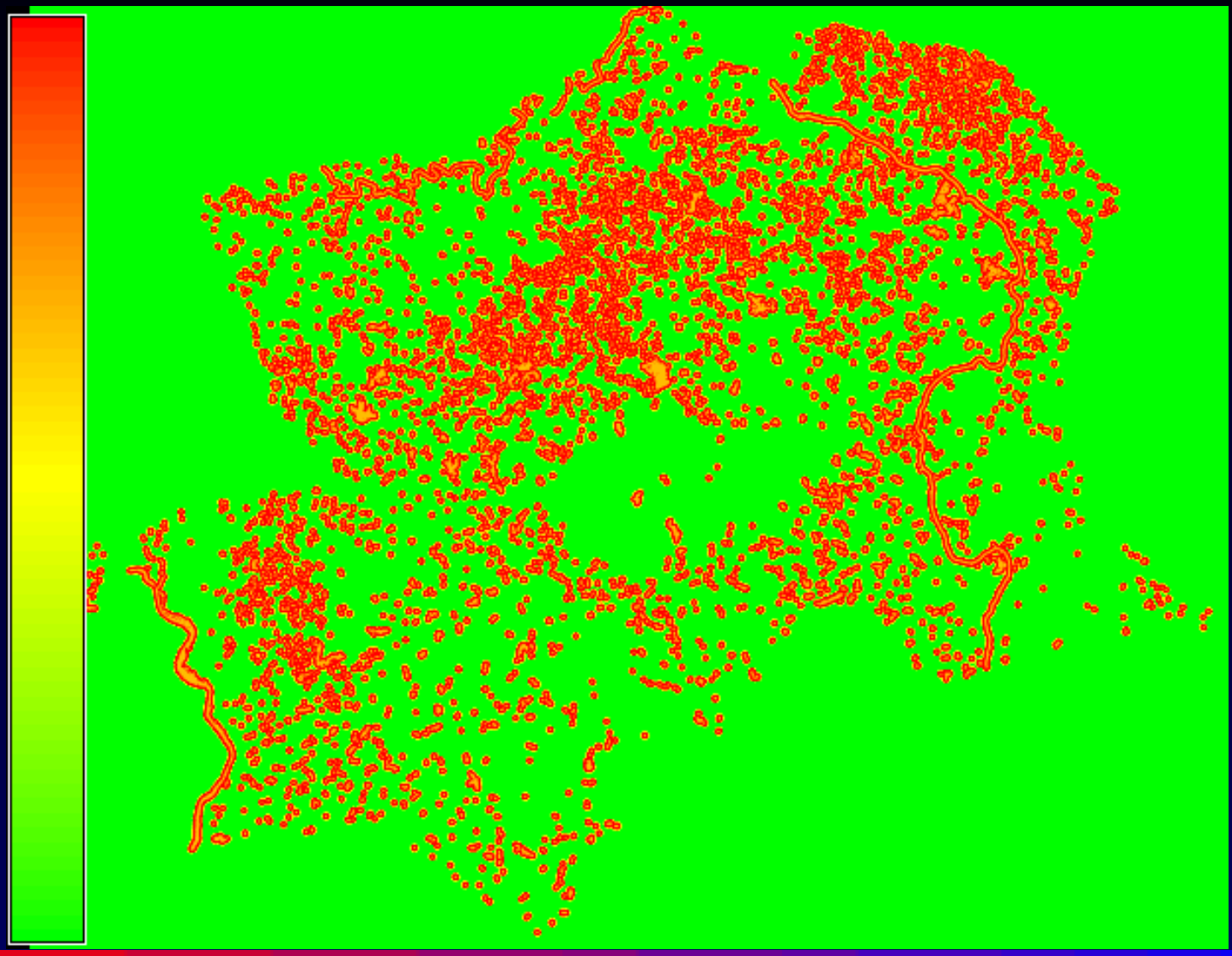
State Road



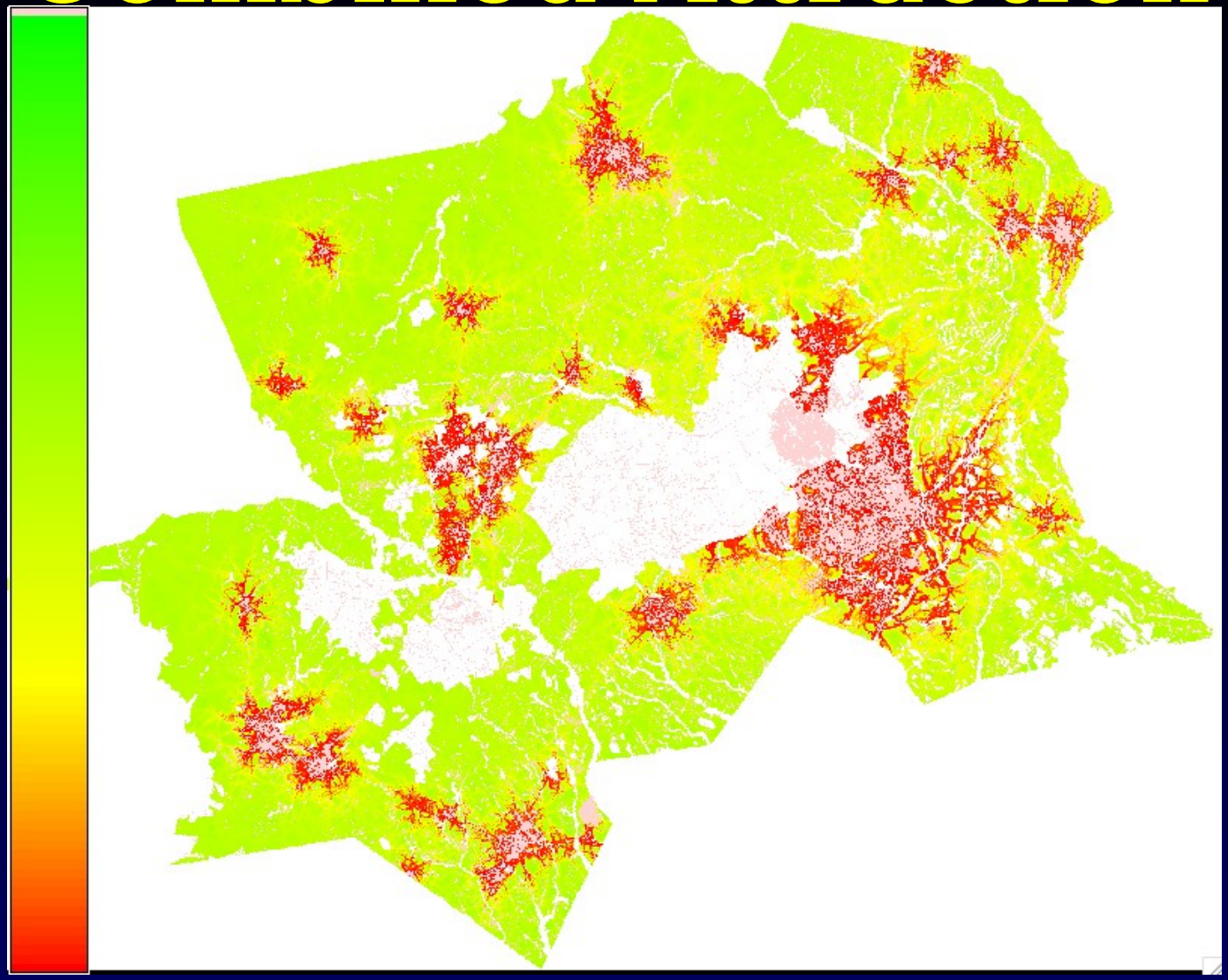
Tree



Water



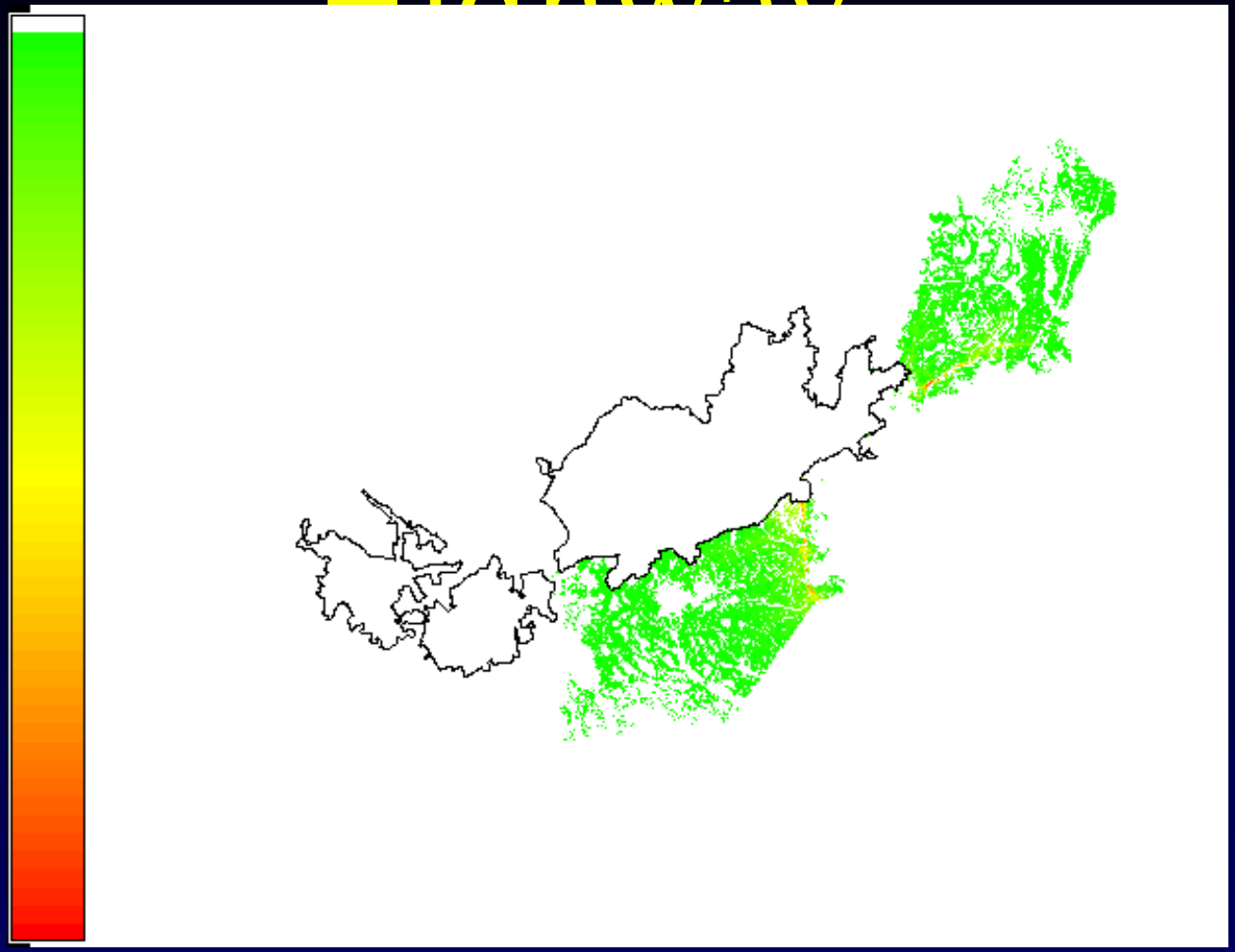
Combined Attraction



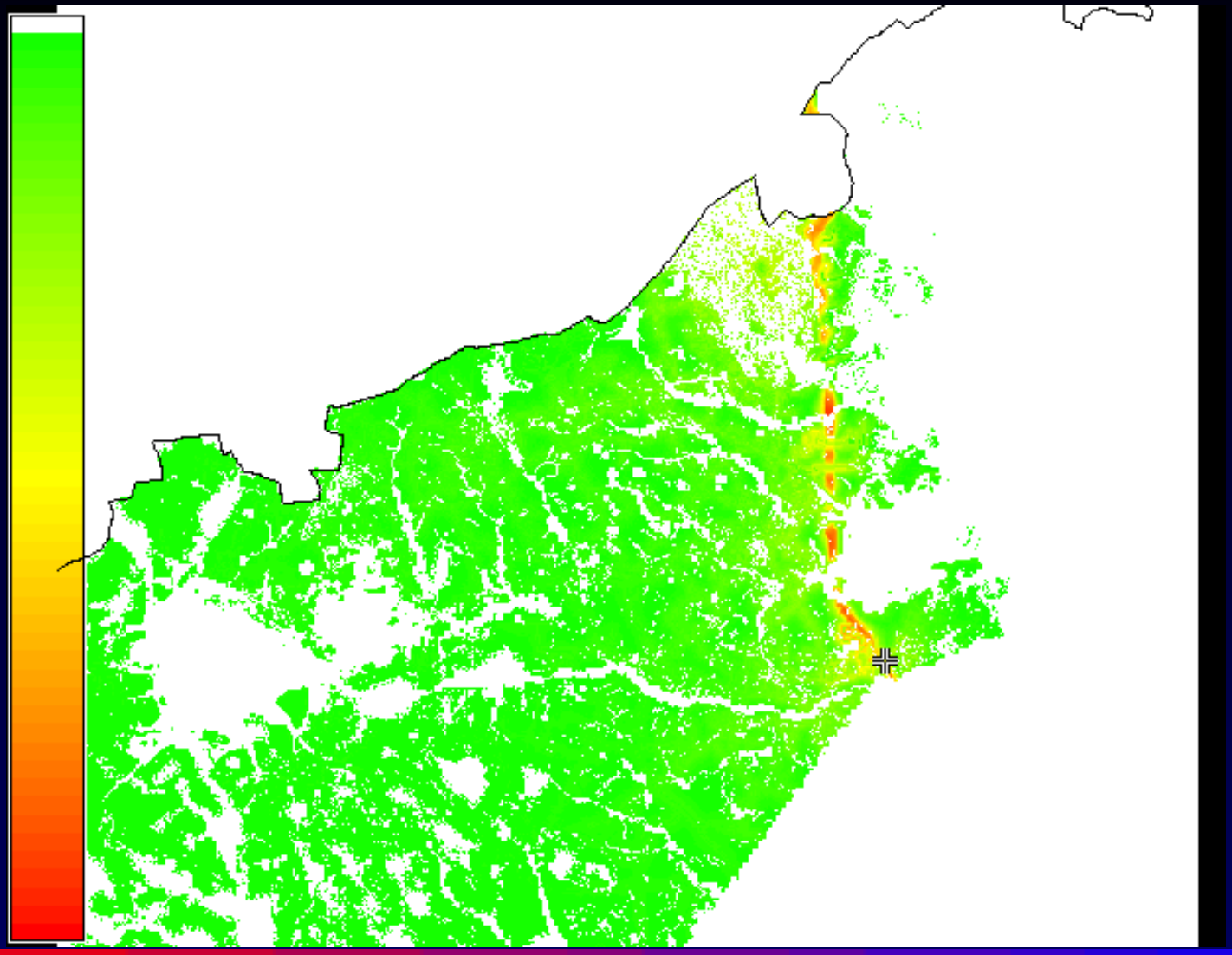
Sample Scenario Analysis

- Scenarios:
  - No new highway
  - New Highway
- Steps
  - Prepare GIS maps
  - Process maps
  - Compare urban attractiveness
  - Run noise tolerance
  - Compare results

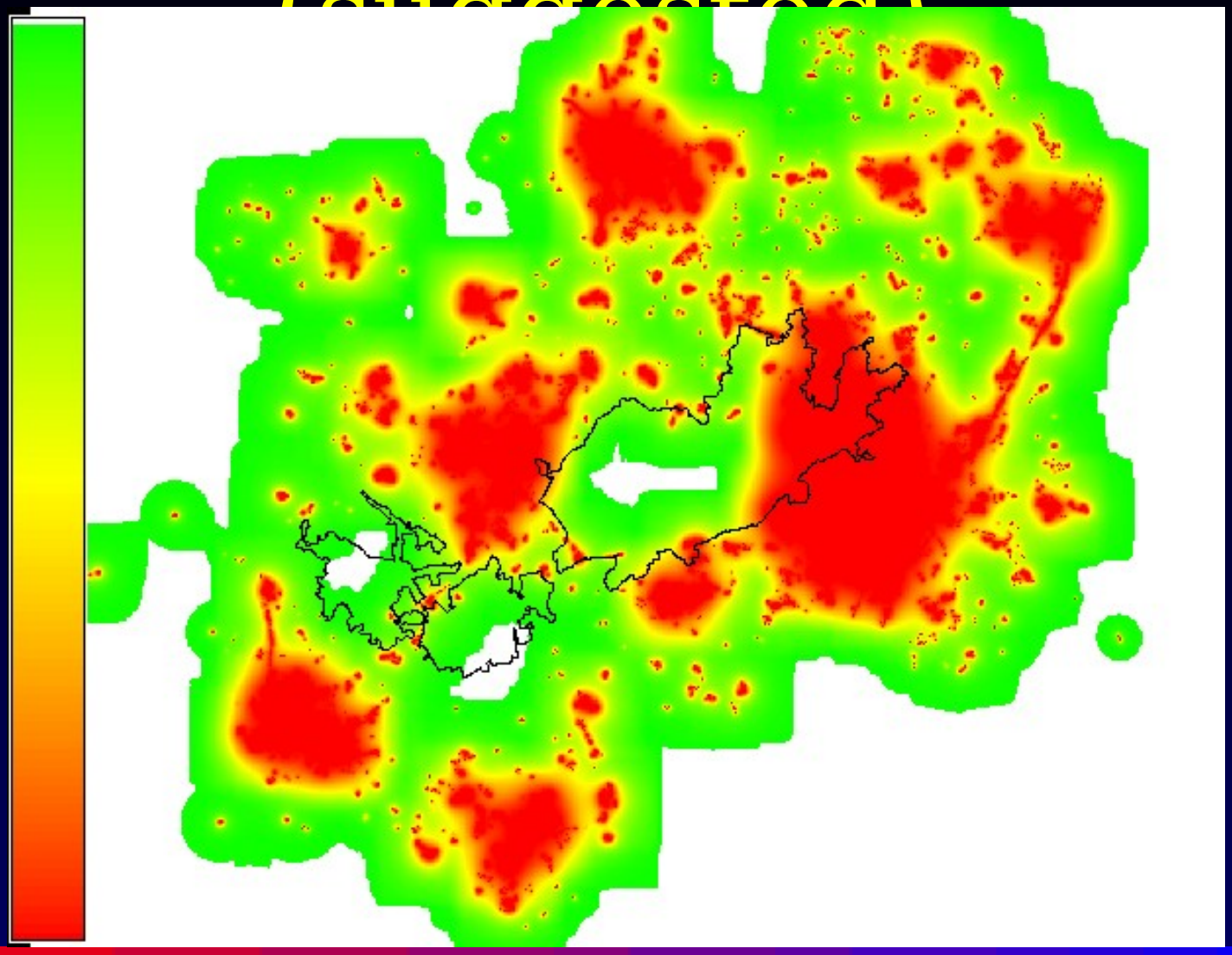
Increase Residential Attractiveness Due to Highway



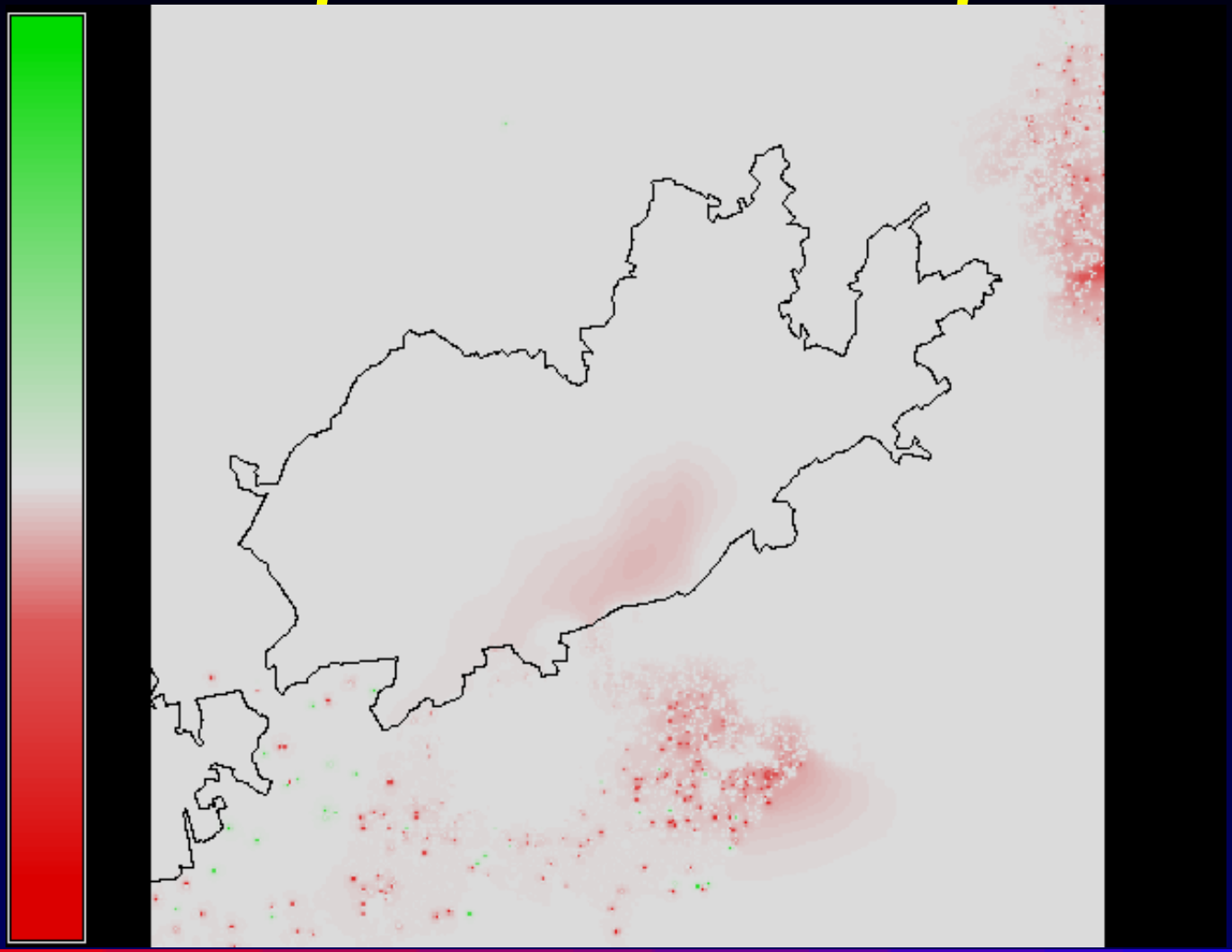
Increase - Zoomed



Noise Tolerance (suggested)



Noise Tolerance Change With Highway



Fort Future Funding Status

- Completed
  - Developed
    - Base urban growth attractiveness
    - Urban growth projection engine
- Next steps (with current funding)
  - Bragg community input on calibration
    - Conversion of facts to 0-1 indicies
    - Weighting of indicies
  - Impact on training/testing
    - Noise, dust/smoke, light tolerance
  - Web interface

Fundable Proposals

- Computer calibration
  - Acquire 2 or more historic land use maps
  - Acquire historic building permit information
  - Calibrate model against this information
- Capture local zoning (city & county)
- Capture local growth differences
  - Which areas are pro-growth?
- Analyze alternative scenarios
  - Predict and evaluate urban growth with respect to
    - RCW habitat & population viability
  - Tolerance to training / testing
    - Noise, dust, smoke, light

Potential Scenarios

- Land (or development right) purchases
- Proposed zoning
- Proposed highway locations
- Proposed subdivisions
- Proposed utilities investments
- Proposed state parks
- Your proposal!!

Summary